Space Weather Technical Forecast

Issued on Thursday, 25 April 2024 at 00:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares expected (R1/R2 blackouts). Chance of isolated G1/Minor Storm intervals from CME or HSS effects. Chance of Active fluence Days 1-2 (25-26 Apr).

Solar Activity: Activity is currently Moderate with several M-class flares observed in the past 24 hours. The largest of these reached M2.0 at 24/2259UTC from the large complex in the southwest. There are currently seventeen sunspot regions on the visible disc. This includes a broad cluster of regions in the southwest which includes AR3638/45/47/43. These regions carry a large percentage of the current flare risk, with the spots magnetically connected and a large amount of flux associated with them, suggesting a potential for X-class flares. However, with this group approaching the western limb it is becoming increasingly difficult to analyse. Elsewhere, AR3654 in the southeast appears to have lost its delta region. AR3648 in the northwest has developed a delta region, and looks like two separate regions which have pushed together. AR3657 in the southeast is also showing some minor magnetic complexity.
Multiple CMEs have been observed in coronagraph imagery over the previous 24hrs, with some potential for the odd glancing blow at Earth.
Solar Wind / Geomagnetic Activity: Solar winds observed by ACE and DSCOVR at L1 were at background levels. Wind speeds varied between 330-380km/s. Density was below average throughout. The Interplanetary Magnetic Field, Bt, was weak at 5nT or below, with the north-south component, Bz, varying weakly between +5/-2nT. Phi angle was initially negative (towards the Sun), switching to positive (away from the Sun) after 24/0600 UTC, then back to negative at 24/1530 UTC. Geomagnetic activity was Quiet (Kp1-2).
Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was generally Moderate, reaching a peak of 1010 pfu at 24/1545 UTC. The associated 24-hour fluence remained below Active (1e8 integrated flux), but with a rising trend, reaching 4.44e7 integrated pfu at 25/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Moderate activity is expected to continue at first, with a slight chance of isolated X-class flares. The cluster of regions in the southwest will fully rotate off the disc late on Day 2 (26 Apr). The flare risk is then expected to decline during Day 3 (27 Apr) as these regions rotate well away from the west limb.
Solar Wind / Geomagnetic Activity: There is a risk of CMEs passing close to Earth throughout the period, largely missing ahead and to the south of our orbit. The greatest potential for any impacts is thought likely to be later Day 2 into early Day 3 (26-27 Apr). Otherwise solar winds are currently at background levels. CH27/+ and CH30/+ in the western disc are likely to bring an increase in wind speeds during this period, most probably during Day 2, with wind speeds perhaps reaching 500-550 km/s.
Overall, geomagnetic activity is likely to be Quiet to Unsettled at first. This has the potential to become Unsettled to Active with a chance of G1/Minor Storm intervals, either under CME or high speed stream influence, or perhaps a combination of both. The risk should decline into Day 4 (28 Apr).

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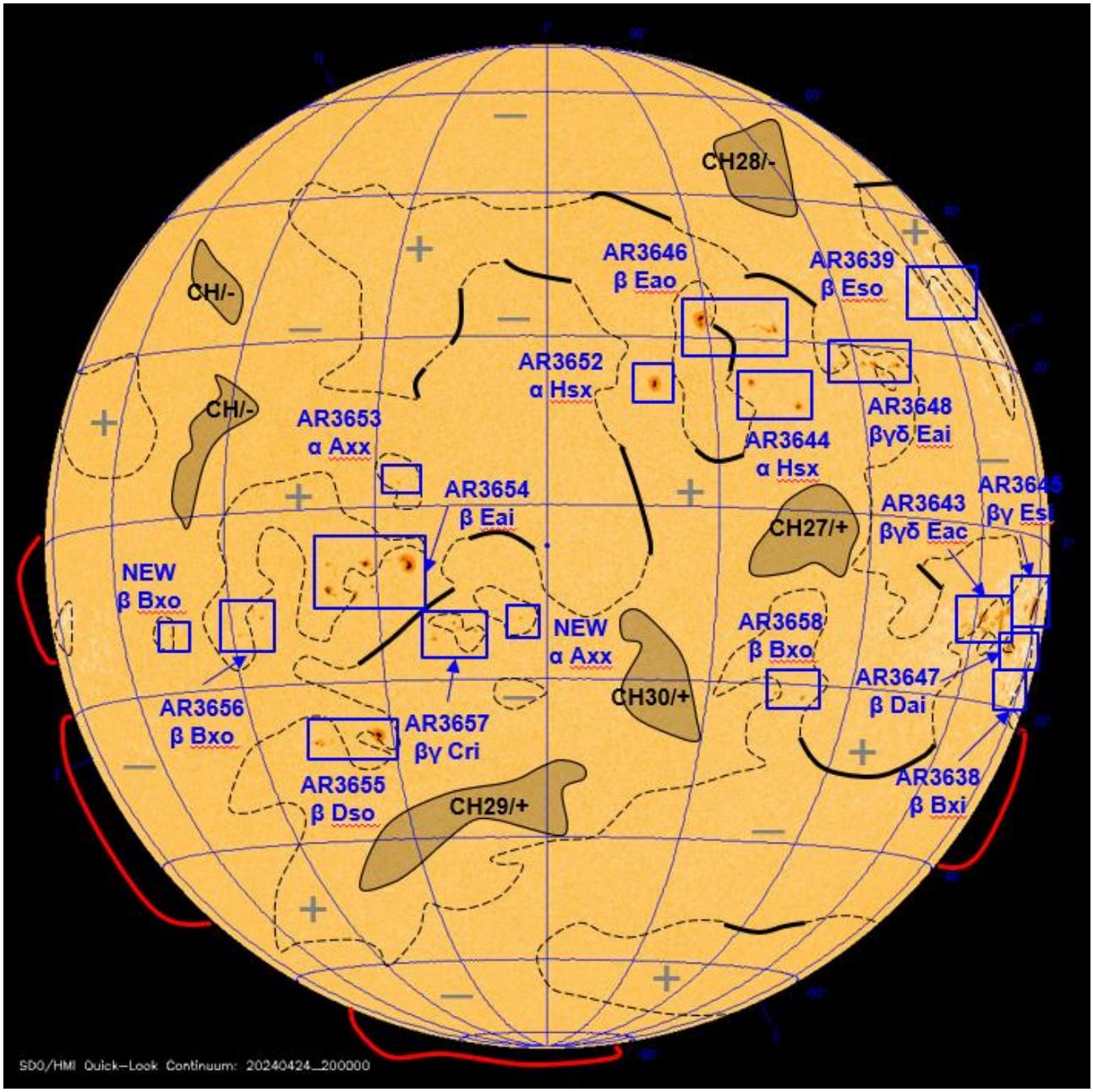
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: High energy proton flux is likely to remain at background levels, but with a slight chance of reaching the S1/Minor Radiation Storm threshold throughout. High energy electron flux as observed by GOES16 may peak at High levels early in the period, but is then likely to decrease with CME and HSS arrivals. The associated 24-hour electron fluence has a chance of reaching Active (1e8 integrated pfu) on Days 1-2 (25-26 Apr), then likely declining.

Figure 1. Solar Analysis Valid 24/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Multiple CMEs, mostly associated with the complex sunspot region in the southwest, have been observed in recent days. Analysis suggests there is a risk of CMEs passing close to Earth throughout the period, largely missing ahead and to the south. For the most part these CMEs are unlikely to give significant impacts, but the greatest potential for any impacts is thought likely to be later Day 2 into early Day 3 (26-27 Apr).

Otherwise solar winds are currently at background conditions. We have both CH27/+ and CH30/+ in the western disc, and these are persistent featues, with the leading edge perhaps a little ahead of the previous rotation. They are likely to bring an increase in wind speeds during this period, most probably during Day 2, with wind speeds perhaps reaching 500-550 km/s based on the previous rotation. Both of these are positive polarity coronal holes however, which are less favoured for geomagnetic connection at this time of year. There is the potential for the high speed stream and CME arrivals to combine though, perhaps slightly increasing the risk of geomagnetic activity.

Overall, geomagnetic activity is likely to be Quiet to Unsettled at first. This has the potential to become Unsettled to Active with a chance of G1/Minor Storm intervals, either under CME or high speed stream influence, or perhaps a combination of both. The risk should decline into Day 4 (28 Apr).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	15	30	25	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Multiple CMEs mostly associated with the complex sunspot region in the southwest have been observed in recent days, with the potential for one or more of these to glance Earth during this period.

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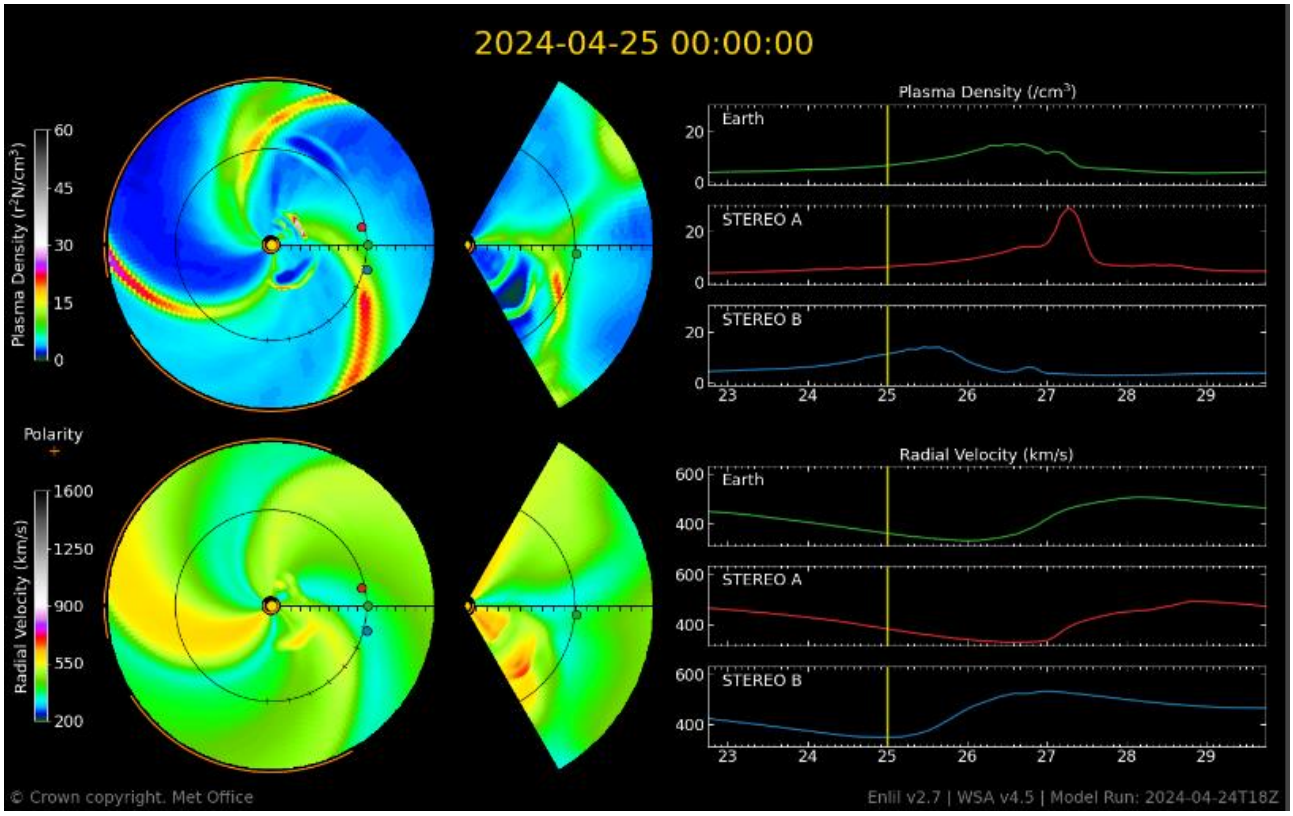
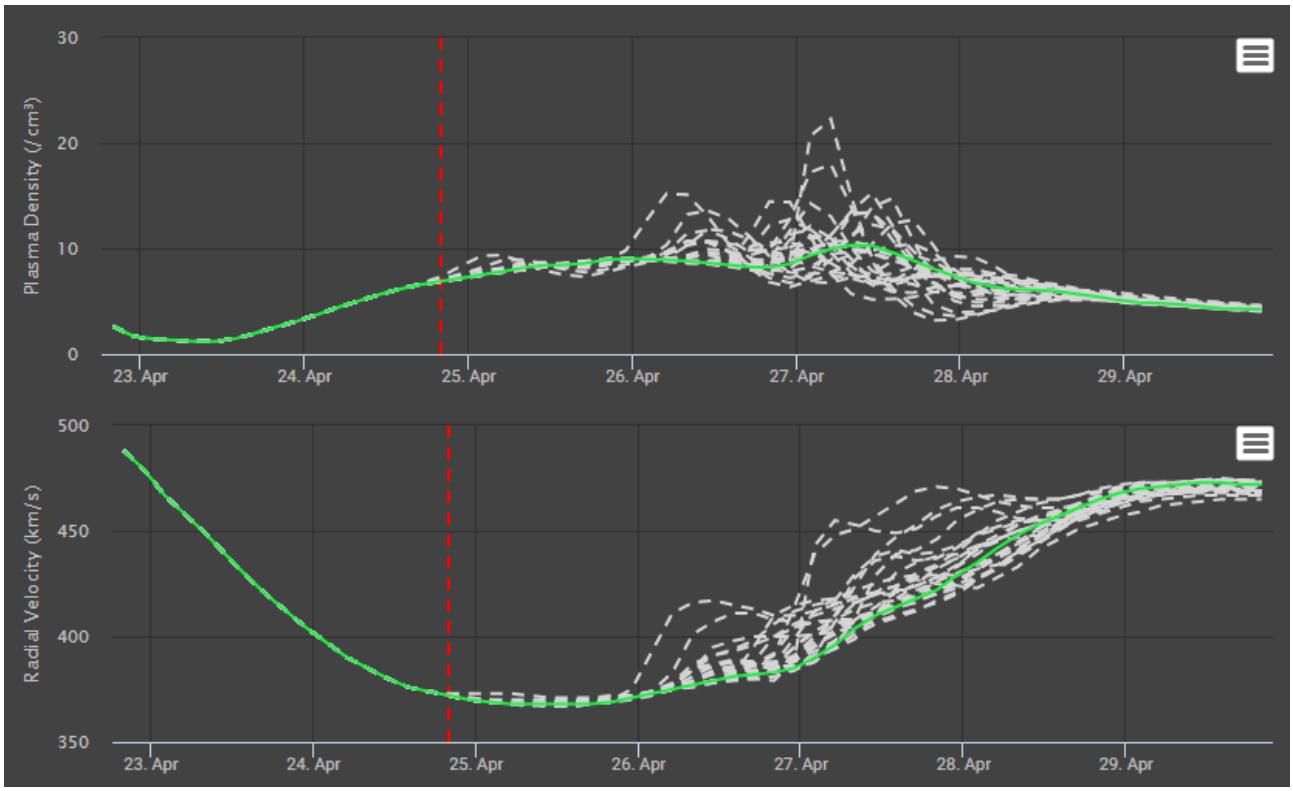
Figure 2: MOSWOC Enlil and ensemble, showing the potential for CME glancing blows. Enlil may be a little late to bring in the high speed stream, with 26 April preferred.





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Radio Blackouts - X-Ray Flares:
There are currently seventeen sunspot regions on the visible disc. This includes a broad cluster of regions in the southwest which includes AR3638/45/47/43. These regions carry a large percentage of the current flare risk, with the spots magnetically connected and a large amount of flux associated with them, suggesting a potential for X-class flares. However, with this group approaching the western limb it is becoming increasingly difficult to analyse. Elsewhere, AR3654 in the southeast appears to have lost its delta region. AR3648 in the northwest has developed a delta region, and looks like two separate regions which have developed together. AR3657 in the southeast is also showing some minor magnetic complexity.

Moderate activity is expected to continue at first, with a slight chance of isolated X-class flares. The cluster of regions in the southwest will start to rotate over the western limb late on Day 1 (25 Apr), finally rotating off late on Day 2 (26 Apr). The flare risk is then expected to decline during Day 3 (27 Apr) as these regions rotate well away from the west limb. With no significant returning regions expected during the period, or currently signalled on far side sounding data to counter balance the loss of flare potential, a general reduction in the flare risk is indicated.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	75	60	40
Very Active	R3 to R5 X Class	No	15	15	10	5

Figure 3: X-ray flux at GOES 16 and 18, showing several low level M-class flares in the last 24 hours.

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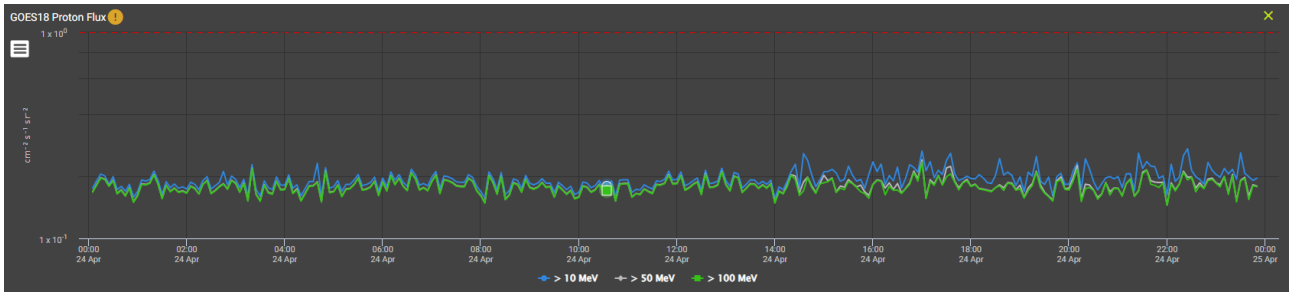
Solar Radiation Storms - (High Energy Protons):
High energy proton flux as observed by GOES18 has persisted at background levels. There remains a slight chance of an increase in proton flux, with the cluster of sunspots in the southwest disc in a good location to give a proton enhancement at Earth. This brings a slight chance of reaching the S1/Minor Solar Radiation Storm level throughout the period. Whilst the complex fully rotates off the disc by the end of Day 2 (26 Apr), the risk of a proton enhancement will remain through the whole of this period until the cluster is well beyond the west limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GOES18, which is at background levels.



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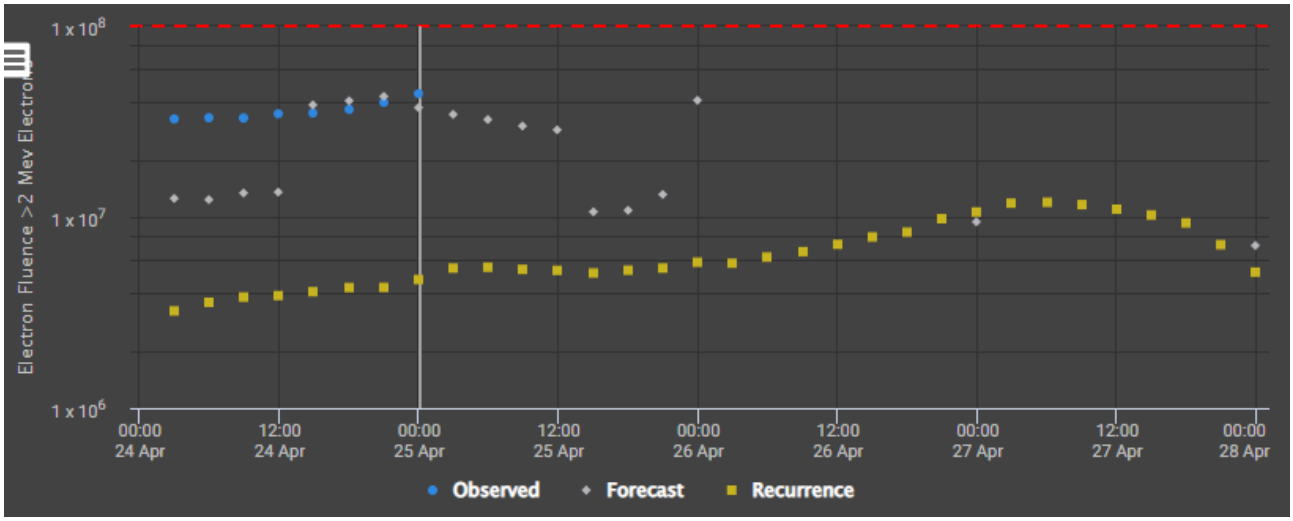
High Energy Electrons Event (≥ 2MeV):
High energy electron flux as observed by GOES16 has been rising over the past few days and very briefly touched High levels during 24 Apr, likely as a result of the CME arrival and HSS onset that occurred during the past week. Now solar winds have returned to background levels, a further slight increase in flux is possible during the next day or two. This is only moderate confidence however, as the arrival of any CMEs, alongside a HSS arrival most likely on Day 2 (26 Apr), is expected to suppress electron flux once again and bring it near to background levels. Any potential increase due to the upcoming HSS and/or CME effects is unlikely to occur until after the end of this period.

The associated 24 hour electron fluence is expected to continue on a slightly increasing trend in the near term, with a chance of reaching Active on Days 1 or 2 (25-26 Apr). The fluence is then likely to follow a sharper declining trend once we see the HSS arrival, and/or any CME arrival. MOSWOC REFM is suggesting a declining trend, but is perhaps a little too fast to bring fluence levels down.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	30	25	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM showing a generally declining trend, which is thought to be a little quick with fluence most probably remaining higher for at least another day before declining.



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